

## APPENDIX E

### Sample Wave-Induced Ship Motion Calculation for Tankers Using the Kimon Method (1982)<sup>1</sup>

E-1. Below are listed the appropriate factors required for wave-induced ship motion calculation using the Kimon method.

- a. Mean draft: Vessel mean draft (ft).
- b. Roll period: Observed or calculated vessel deep water natural roll period (sec). If unknown, 10 sec is a good estimate.
- c. Pitch period: Observed or calculated vessel deep water natural pitch period (sec). If unknown, 10 sec is a good estimate.
- d. Vessel speed: (knots).
- e. Wave period: (sec).
- f. Mean wave height: (ft).
- g. Relative wave heading: Head seas: 0 deg; Bow seas:  $\pm 45$  Beam seas:  $\pm 90$  deg; Quartering seas:  $\pm 135$  deg; Following seas: 180 deg.
- h. Water depth: (ft).
- i. Channel length: nautical miles.

E-2. The following is a sample calculation for a 250 KDWT tanker.

- a. Mean draft: 49 ft (given).
- b. Roll period: 10 sec (given).
- c. Pitch period: 10 sec (given).
- d. Vessel speed: 3 knots (given).
- e. Channel length: 3 nm (given).
- f. Vessel deadweight: 279,700 long tons (given).
- g. Water depth: 55 ft (given).
- h. Wave period: 10 sec (given).

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<sup>1</sup> Kimon, P. M. 1982. "Underkeel Clearance in Ports," Report No. EII.17TM.82, Exxon International, Tanker Dpt-R&D, Forum Park, NJ.

- i. Mean wave height: 3 ft (given).
- j. Relative wave heading: 90 deg (given).
- k. Wave period/Roll period: 1.0.
- l. Wave period/Pitch period: 1.0.
- m. Water depth/Ship draft: 1.12.
- n. RMS response for 200 KDWT tanker in 1-ft seas (Figure E-1): 0.57 ft.
- o. RMS response for 200 KDWT tanker at given wave ht: (Line 8 H Line 13): 1.7 ft.
- p. Displacement response ratio (Figure E-2): 0.9.
- q. RMS response for given vessel (Line 15 H Line 16): 1.5 ft.
- r. Period of encounter (Figure E-3): 10 sec.
- s. Number of wave encounters (Line 5/Line 4 \* 3600/Line 18): 360.
- t. Wave encounter multiplier (Figure E-4): 4.6.
- u. Wave allowance for underkeel clearance (Line 17 H Line 20): 6.9 ft.

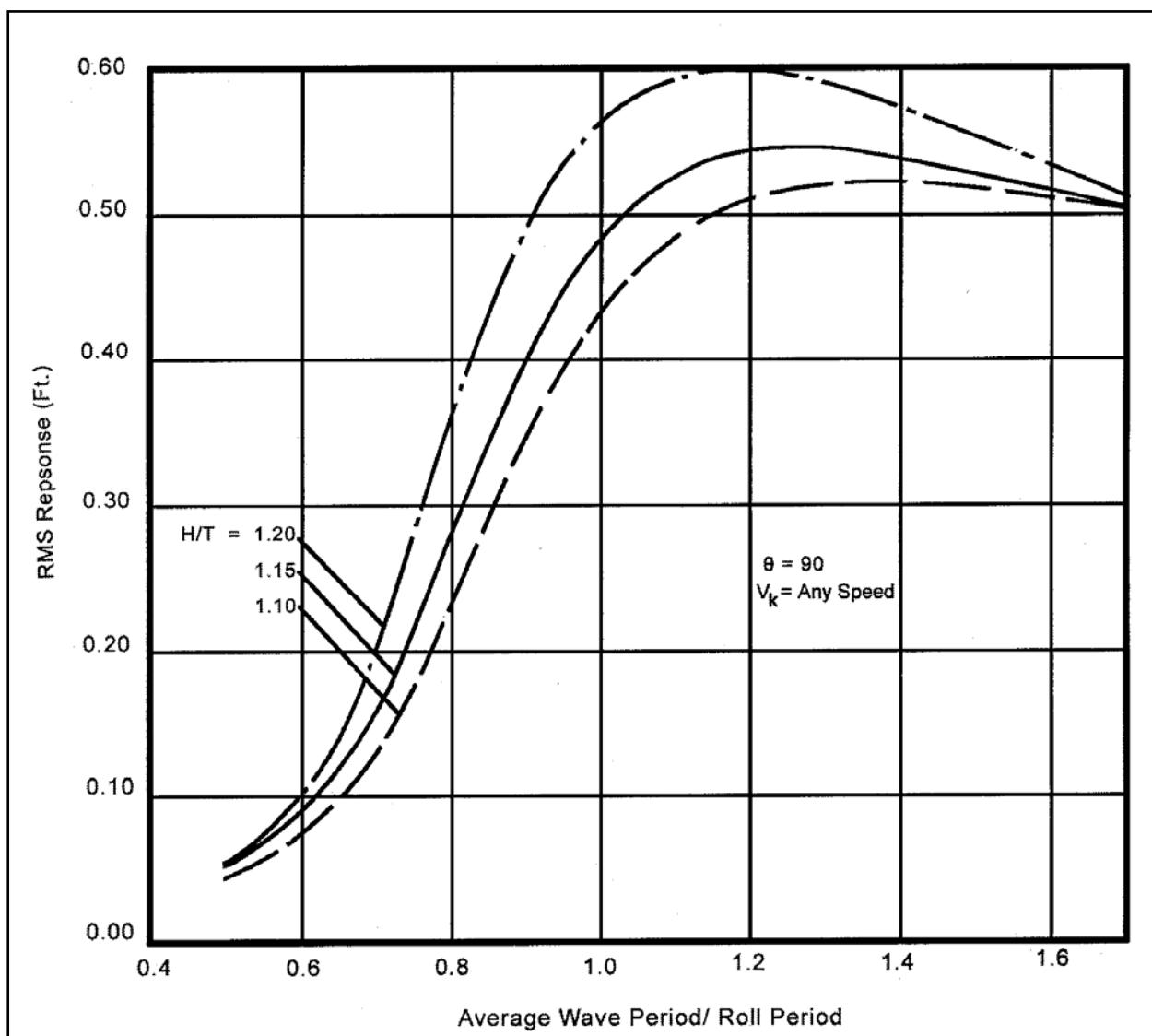


Figure E-1. Beam sea response,  $V_k = \text{any speed}$

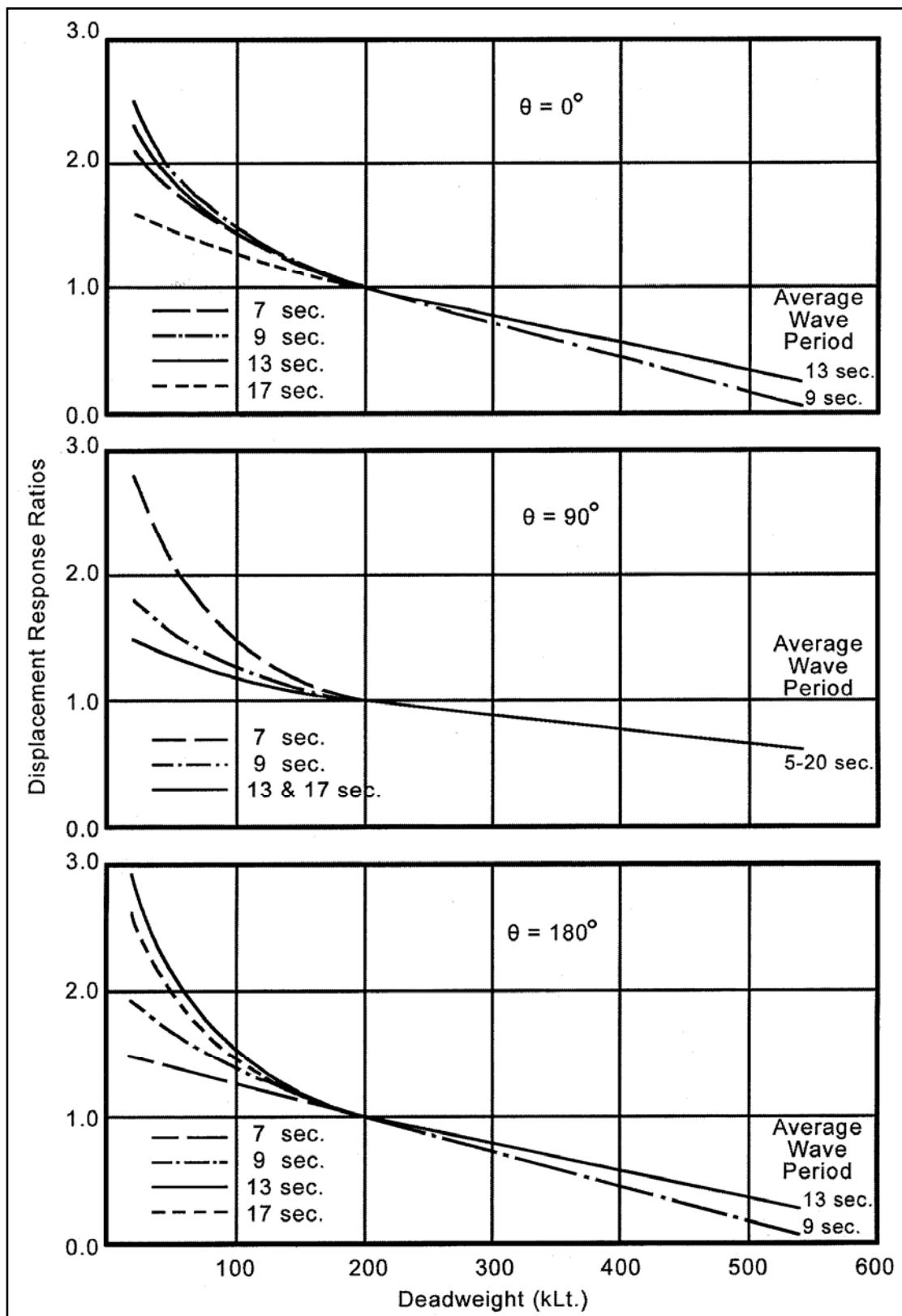


Figure E-2. Displacement response ratios

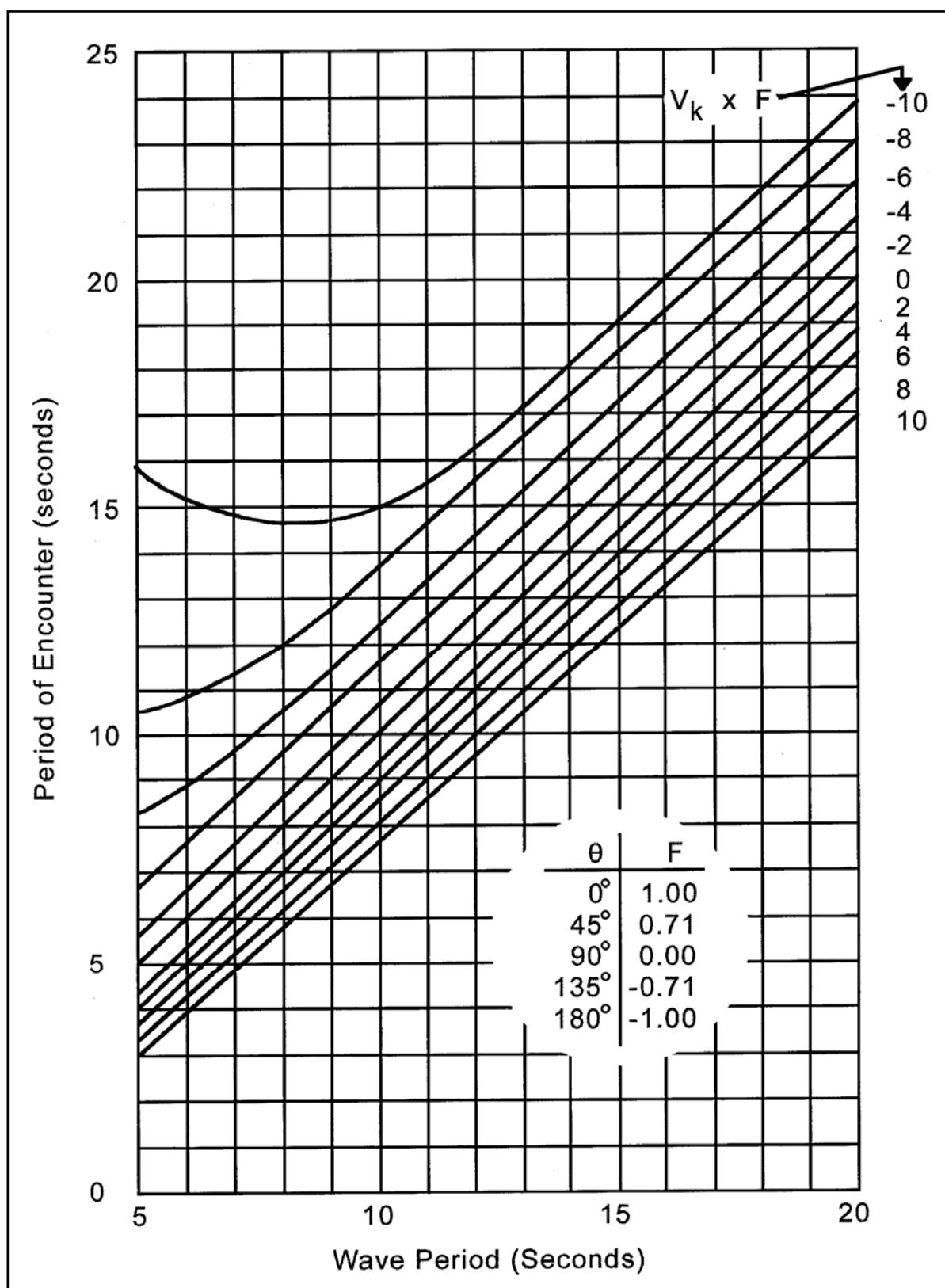


Figure E-3. Wave encounter period

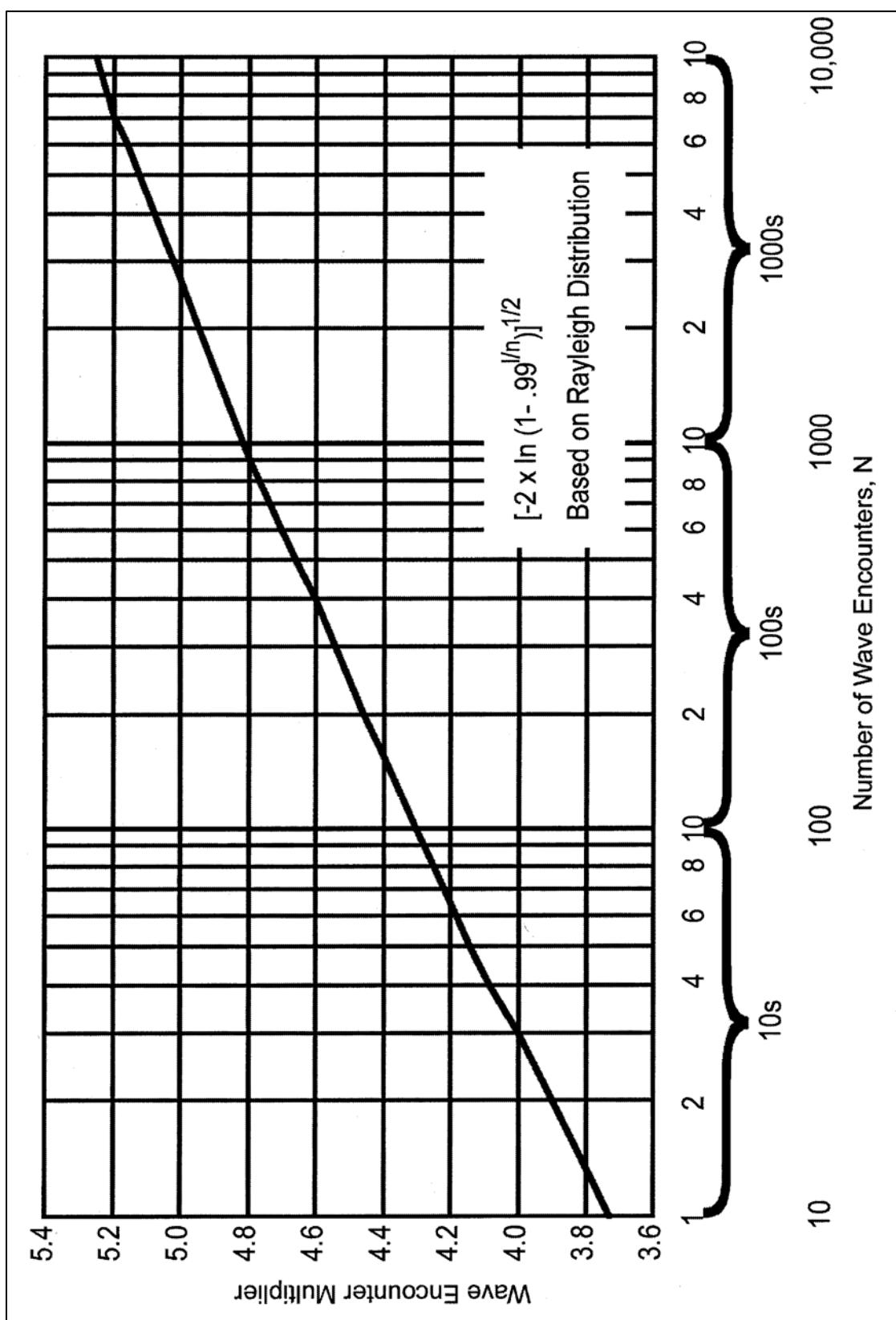


Figure E-4. Wave encounter multiplier